MODEL 132A
PULSE GENERATOR

E-H RESEARCH LABORATORIES, INC.
163 ADELINE STREET • OAKLAND, CALIFORNIA 94607

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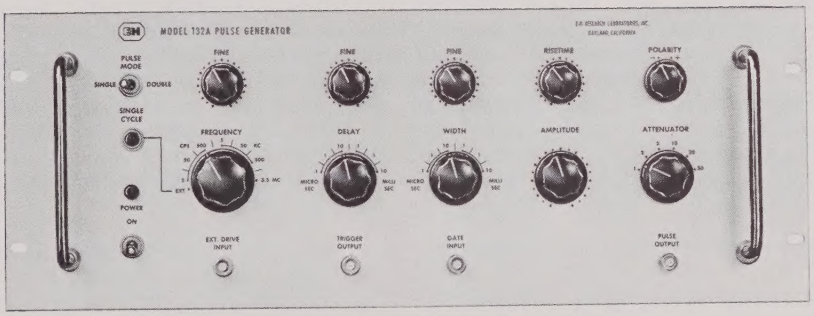
PULSE GENERATOR



E-H RESEARCH LABORATORIES, INC.
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FOREWORD

Units, abbreviations and prefixes of the International System of Units (SI) are used in this manual. Discrepancies may be noted between the terms used in the text and the instrument panel markings (e. g. ; hertz, kilohertz, megahertz for cps, kilocycles, megacycles, etc.)

The National Bureau of Standards announced its approval of the SI in February 1964, and subsequently the document was adopted by Congress as a national standard.

SECTION 1
CHARACTERISTICS

1-1 GENERAL

The E-H Model 132A Pulse Generator is designed to provide fast risetime, high current pulses over a broad range of pulse widths and repetition rates. It is suitable for a variety of applications including design problems involving magnetic materials, solid state research, high-speed diode and transistor switching characteristics, and high-current logic and memory circuits. It includes provisions for external driving or gating, provides a trigger for sync purposes, and an output attenuator.

The Model 132A uses unique latched output circuitry to form the pulse. This method of pulse generation was developed by E-H, and is the reason for the broad capabilities of the Model 132A. Basically, the latch is a bistable circuit. One stable state is zero output volts, and the other stable state is some positive or negative output that is determined by the AMPLITUDE and POLARITY controls. The latch is triggered from one state to the other by a series of trigger pulses generated by the timing circuits. The latch switches states in typically 10 nanoseconds -- providing the fast risetime pulses specified.

One of the most important features of the latch circuitry is the freedom of all waveform adjustment controls. The output pulse is extremely clean and fast under all conditions of amplitude, repetition rate, pulse width, etc. No "trimming up" of the pulse is required. The only waveform control is the front-panel RISETIME control, which is provided as a convenience to the user.

The timing circuit of the Model 132A is entirely transistorized to ensure reliable operation indefinitely. The vacuum tube in the output latch is a premium-type that is rated for 10,000 hours life. In addition, the Model 132A has been quality constructed to provide long trouble-free operation.

1-2 SPECIFICATIONS

REPETITION RATES: 5 hertz to 3.5 megahertz internally selected by front panel step and vernier controls. The instrument may be externally driven from zero to 3.5 megahertz by a negative 4 volt pulse.

RISETIME: Positive pulse; less than 12 nanoseconds; variable to more than 100 nanoseconds. Negative pulse; less than 10 nanoseconds; variable to more than 100 nanoseconds.

FALLTIME: Less than 14 nanoseconds, either polarity.

PULSE OUTPUT: The maximum pulse amplitude is 50 volts into 50 ohms, either polarity. An amplitude control and step attenuator provide continuous attenuation to 150:1.

PULSE WIDTH: Less than 100 nanoseconds to more than 10 milliseconds, continuously variable by step and vernier controls.

PULSE DELAY: Less than 100 nanoseconds to more than 10 milliseconds, continuously variable by step and vernier controls.

DUTY FACTOR: The maximum average current out is 250 milliamps. Thus, a 25% duty factor is available at 50 volts amplitude and a 50% duty factor is available at 25 volts amplitude. Automatic limiting prevents overload.

DROOP: 5% or less at 10 milliseconds width.

POLARITY: Output pulses are either positive or negative, but not simultaneous.

TRIGGER OUTPUT: A 4 volt negative pulse, into 2K ohms, approximately 50 nanoseconds wide, is provided for sync purposes.

GATE: A 5 volt negative signal at the GATE INPUT will interrupt the pulse train for the duration of its presence. Input impedance is 2.4K ohms.

DOUBLE PULSE: A front panel switch provides either single or double pulse operation. In double pulse mode, maximum repetition rate is 500 kilohertz for 1 megahertz double pulse rate. Pulses are identical in amplitude, width and polarity. Minimum spacing is approximately three times the pulse width. Spacing is determined by the DELAY control.

SINGLE CYCLE: A front panel pushbutton provides single cycle operation.

DIMENSIONS: Rack Mounted: 19" wide, 7" high. End frames are available for bench use. Weight: 22 lbs. net; 30 lbs. packed; 42 lbs. packed for export.

POWER REQUIREMENTS: 105/125 volts, 50/60 cycles, 200 volt-amperes.

1-3 ACCESSORIES

END FRAMES are available for bench use.

For short pulses, the E-H Model ZT-SERIES PULSE TRANSFORMERS invert the output pulse or match other impedances. Standard impedances are any permutation of 50, 93, 125, 185, or 200 ohms, normal or inverting. Coaxial body with BNC connectors.

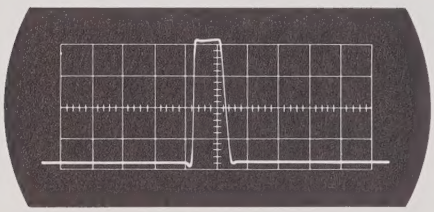
E-H Model RT RISETIME INTEGRATORS. These provide precise risetimes in applications where responses to slow risetimes are important. Standard risetimes of 5, 10, 20, and 100 nanoseconds; other values on special order.

E-H Model 921 VARIABLE DELAY GENERATOR may be used between an external driving source and Model 132A to obtain precise positioning; or between two or more Models 132A's. Continuously variable delays from 50 nanoseconds to 100 microseconds.

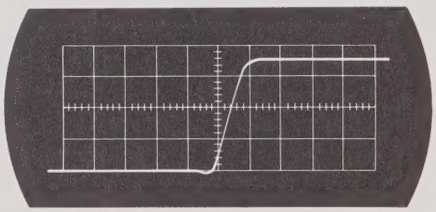
ADDITIONAL ACCESSORIES. The E-H BNC Series accessories are compatible with the E-H Model 132A and other instruments with BNC connectors. For further accessory information, refer to the data at the back of this manual.

1-4 APPLICATIONS

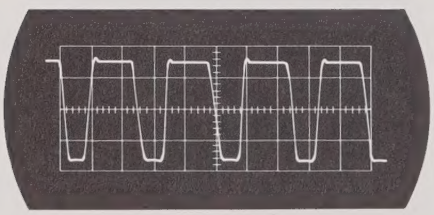
For more information concerning applications, pulse definitions, and pulse generating circuits, consult the E-H booklet entitled "Pulse Generators."



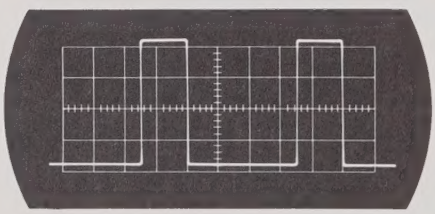
Positive pulse.
10v/cm, 100ns/cm.



Leading edge of positive pulse.
15v/cm, 10ns/cm.



Negative pulse train at max. rep rate.
10v/cm, 100ns/cm.



Positive pulse train.
10 v/cm, 10μs/cm.

Figure 1-1. E-H Model 132A - Typical waveforms.
(All waveforms observed on a Tektronix Type 545 oscilloscope with Type "L" plug-in.)

SECTION 2
OPERATING INFORMATION

2-1 UNPACKING

Immediately after unpacking the instrument, carefully inspect and evaluate the condition of the shipping container and instrument for evidence of damage that might have occurred during shipment or handling. If damage is noted, the responsible carrier or agency should be promptly notified.

2-2 234 VOLT OPERATION

The internal power supply of the Model 132A is normally wired for 117 vac operation. Simple rewiring of the transformer primary permits operation at 234 volts. Refer to the schematic diagram at the back of this manual for the proper primary connections.

2-3 OUTPUT IMPEDANCE

The Model 132A is a current source when the output pulse is negative and a voltage source when the output pulse is positive. Although the impedance at the PULSE OUTPUT connector is not 50 ohms, the instrument is designed to operate into a 50-ohm resistive load. Operation into any other impedance will cause some pulse distortion. Loads with appreciable capacitive or inductive components will have a marked effect on the leading and trailing edges of the pulse.

Use the Model ZT Pulse Transformer to match the Model 132A output to other impedances.

NOTE

For best waveform fidelity, the Model 132A terminating impedance should always be as close to 50 ohms as possible.

2-4 CABLES, CONNECTORS AND ATTENUATORS

The sharp rising pulse of the 132A has appreciable frequency components up to 35 megahertz. If any of these high frequency components are attenuated through the use of connectors, cables, or attenuators that do not have a flat frequency response in excess of these frequencies, degradation of the pulse risetime will result. Mismatch effects can also degrade the pulse waveform: consequently, consideration and care must be taken to preserve the quality of the Model 132A pulse output when coupling it to the system or device under test.

Some of the precautions to observe in coupling the pulse outputs of this instrument are:

1) Always terminate the PULSE OUTPUT of the Model 132A in a 50-ohm resistive load.

2) If the input impedance of the device or system under test is other than 50 ohms, use an impedance matching device so that mismatch effects will not degrade the pulse waveform.

3) Make sure that all connectors, attenuators, and cables are of proper impedance and have a flat frequency response in excess of 35 megacycles. The GR and Tektronix coaxial attenuators are recommended for use. Only high-quality 50-ohm cable should be used at the Model 132A BNC PULSE OUTPUT connector such as RG-58C/U or RG-213/U.

2-5 OPERATING CONTROLS AND CONNECTORS

The front panel operating controls, and the function of each, are listed in Table 2-1.

2-6 DUTY FACTOR

The duty factor limitation ensures conservative operation and long life of the output tubes. The duty factor is controlled electronically by monitoring the output current to maintain it at a maximum of 250 milliamperes, average. Effectively, when the duty factor reaches 25 per cent, the amplitude of the output pulse is proportionately decreased as the duty factor is increased.

NOTE

The minimum available pulse width and the duty factor limitation prevents full output at 3.5 megahertz.

Typically, pulse widths of up to 80 per cent of the period can be obtained. Extending the pulse width past the normal period will cause the generator to scale down in frequency, or unusual pulse distortion conditions to appear. At no time, however, can damage occur to the instrument.

TABLE 2-1 OPERATING CONTROLS AND CONNECTORS

ITEM	FUNCTION
POWER	Connect the line cord to a 115 vac 50/60 Hz power source. Turn the POWER switch to ON. The fan will start, and the POWER lamp will light.
FREQUENCY	Pulse repetition frequency is variable in decade steps by the coarse FREQUENCY selector switch. The FINE control serves as a vernier for each range. With these controls, the pulse repetition frequency is continuously variable from 5 Hz to 3.5 megahertz with overlap to adjacent ranges.
DELAY	The DELAY controls vary the time between the trigger pulse and the output pulse. Delay time is variable in decade steps by the coarse DELAY selector switch. The FINE control serves as a vernier for each range. Delay time is continuously variable from 100 nanoseconds to 10 milliseconds, with overlap to adjacent ranges.
WIDTH	The WIDTH controls vary the pulse width; width is variable in decade steps by the coarse WIDTH selector switch. The FINE control serves as a vernier for each range. These controls permit pulse width to be continuously variable from 100 nanoseconds to 10 milliseconds, with overlap to adjacent ranges.
AMPLITUDE	The amplitude of the output pulse is continuously variable over an approximate 3:1 range by the AMPLITUDE control.
ATTENUATOR	The ATTENUATOR provides six step attenuation ratios from 1:1 to 50:1.
POLARITY	The POLARITY switch selects either positive or negative output pulses.
RISETIME	The RISETIME control varies the leading edge risetime for 12 to 100 nanoseconds.
SINGLE CYCLE	The SINGLE CYCLE control provides a single output pulse each time the SINGLE CYCLE button is depressed. To operate, turn the FREQUENCY selector switch to EXT. with the FINE frequency vernier turned fully counterclockwise.
PULSE MODE SINGLE - DOUBLE	The PULSE MODE switch provides for the addition of a second pulse to the normal output pulse train, when required. For SINGLE operation, there is one output pulse during the pulse repetition period; it follows the trigger pulse by the delay time. During DOUBLE operation, a second pulse is added to the output pulse train during the pulse repetition period; the second pulse is approximately coincident with the trigger pulse. The trigger coincident pulse is separated from the original pulse by the delay time. (Continued)

ITEM	FUNCTION
	The DOUBLE pulse mode is operational from 5 Hz to 500 kilohertz, but is inhibited in the highest FREQUENCY range (500 kilohertz to 3.5 megahertz). For best results, the output pulse width should be less than approximately one third of the delay time, and delay time should be less than the pulse repetition period.
EXT. DRIVE INPUT CONNECTOR	Turn the FREQUENCY range selector switch to EXT. and the FINE frequency vernier fully counterclockwise. Apply the negative 4 volt drive signal to the EXT. DRIVE INPUT connector.
GATE INPUT CONNECTOR	A negative 5 volt signal applied to the GATE INPUT will interrupt the output pulse train as long as the signal remains.
PULSE OUTPUT CONNECTOR	The output pulse train is taken from the PULSE OUTPUT connector. The output is designed to operate into a 50-ohm, resistive load. The Model 132A should always be operated with a load at the output.
TRIGGER OUTPUT CONNECTOR	The TRIGGER OUTPUT connector delivers a negative 5 volt pulse which is useful for synchronizing oscilloscopes or other instruments. For best results, operate with a 50-ohm load, such as a 50-ohm isolation pad or an attenuator.

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SECTION 3
PARTS LIST

3-1 ORDERING INFORMATION

Replacement parts may be ordered through your E-H Representative or from the factory. To be certain that you receive the proper replacement parts, always include the following information with your order:

a. Model Number and Serial Number of the instrument on which the replacement parts will be installed.

b. Circuit or Drawing Reference for which each part is intended.

c. E-H Part Number.

This instrument contains several factory-selected components to ensure optimum performance. In no case should a diode or transistor be replaced with one from a different manufacturer, unless it is on the specific recommendation of E-H.

When replacement parts are necessary, be sure to order through the E-H Customer Service organization. In this way, we can best serve you by providing up-to-date factory recommended parts and service information.

3-2 WARRANTY

This instrument is guaranteed to be free from defects in material and workmanship. Our obligation is limited to repairing the instrument should it prove to be defective, upon our examination, within one (1) year after the purchase date. Fuses and batteries are specifically excluded from warranty. Electron tubes, transistors, and diodes are warranted for six (6) months.

For In-Warranty repair of this instrument, contact E-H Research Laboratories, Inc., Customer Service Department, and provide:

a. Instrument Model Number and Serial Number.

b. Full details concerning the nature of the malfunction.

Shipping instructions, or repair information and parts, will be sent to you promptly.

CUSTOMER SERVICE DEPARTMENT, E-H RESEARCH LABORATORIES, INC.

163 ADELINE STREET, OAKLAND, CALIFORNIA -Phone: TE 4-3030, Area Code 415

3-3 CAPACITORS

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
C1	47 μf, ±20%, 20v, Tantalum	318-001
C2	4.7 μf, ±20%, 20v, Tantalum	318-002
C3	.5 μf, ±5%, 200v, Mylar	320-009
C4	.05 μf, ±5%, 200v, Mylar	320-005
C5	.005 μf, ±5%, 500v, Polystyrene	326-004
C6	500 pf, ±10%, 1kv, Ceramic	311-009
C7	.001 μf, ±5%, 500v, Poly.	326-005
C8	25 μf, 25 wvdc, Electrolytic	316-028
C9	.01 μf, ±20%, 600v, Ceramic	311-012
C10	25 μf, 25 wvdc, Electrolytic	316-028
C11	.01 μf, ±20%, 600v, Ceramic	311-012
C12	10 pf, ±10%, 1kv, Ceramic	311-001
C13	100 pf, ±10%, 1kv, Ceramic	311-007
C14	.01 μf, ±20%, 600v, Ceramic	311-012
C15	150 pf, ±10%, 1kv, Ceramic	311-008
C16	.001 μf, ±5%, 500v, Polystyrene	326-005
C17	.01 μf, ±5%, 500v, Polystyrene	326-006
C18	.1 μf, ±5%, 200v, Metalized Myl.	320-007
C19	1 μf, ±5%, 200v, Mylar	320-011
C20	10 μf, ±10%, 20wvdc, Tantalum	318-005
C21	25 μf, 25 wvdc, Electrolytic	316-028
C22	.01 μf, ±20%, 600v, Ceramic	311-012
C23	25 μf, 25 wvdc, Electrolytic	316-028
C24	.01 μf, ±20%, 600v, Ceramic	311-012
C25	25 μf, 25 wvdc, Electrolytic	316-028
C26	.01 μf, ±20%, 600v, Ceramic	311-012
C27	25 μf, 25 wvdc, Electrolytic	316-028
C28	.01 μf, ±20%, 600v, Ceramic	311-012
C29	.001 μf, ±5%, 500v Polystyrene	326-005
C30	.01 μf, ±5%, 500v, Polystyrene	326-006
C31	.1 μf, ±5%, 200v, Metalized Myl.	320-007
C32	1 μf, ±5%, 200v, Metalized Myl.	320-011
C33	10 μf, 20v, Tantalum	318-005
C34	.01 μf, ±20%, 600v, Ceramic	311-012
C35	25 μf, 25 wvdc, Electrolytic	316-028
C36	100 pf, ±10%, 1kv, Ceramic	311-007
C37	150 pf, ±10%, 1kv, Ceramic	311-008
C38	100 pf, ±10%, 1kv, Ceramic	311-007
C39	.001 μf, ±10%, 1kv, Ceramic	311-010
C40	50 pf, ±10%, 1kv, Ceramic	311-006
C41	.01 μf, ±20%, 600v, Ceramic	311-012
C42	25 μf, 25 wvdc, Electrolytic	316-028
C43	.1 μf, +80-30%, 75v, Ceramic	311-014
C44	.1 μf, +80-20%, 500v, Ceramic	311-023
C45	.01 μf, ±20%, 600v, Ceramic	311-012
C46	1 μf, ±5%, 200v, Metalized Myl.	320-011
C47	.01 μf, ±20%, 600v, Ceramic	311-012
C48	.01 μf, ±20%, 600v, Ceramic	311-012
C49	7-100 pf, 250v, Variable, Ceramic	332-003
C50	100 pf, ±10%, 1kv, Ceramic	311-007
C51	.01 ±20%, 600v, Ceramic	311-012
C52	.01 μf, ±20%, 600v, Ceramic	311-012
C53	100 pf, ±10%, 1kv, Ceramic	311-007
C57	.01 μf, ±20%, 600 v	311-012
C101	250 μf, 300 wvdc, Electrolytic	316-040
C102	100 μf, 450 wvdc, Electrolytic	316-008
C103	100 μf, 450 wvdc, Electrolytic	316-008
C104	1 μf, ±20%, 200v, Mylar	320-010
C105	.1 μf, +80-30%, 75 wvdc, Cer.	311-014
C106	250 μf, 12 wvdc, Electrolytic	316-031
C107	500 pf, ±10%, 1kv, Ceramic	311-009
C108	100-100 μf, 350 wvdc, Electrolytic	316-022
C109	4000 μf, 15 wvdc, Electrolytic	316-003
C110	4000 μf, 15 wvdc, Electrolytic	316-003
C111	250 μf, 12 wvdc, Electrolytic	316-031
C112	250 μf, 12 wvdc, Electrolytic	316-031
C113	250 μf, 12 wvdc, Electrolytic	316-031
C114	250 μf, 12 wvdc, Electrolytic	316-031

3-4 DIODES

CR1	1N746A; 3.3v ±5%, 400 mw zener	374-017
CR2	Not used	
CR3	1N751A; 5.1v, ±5%, 400 mw zener	374-022
CR4	1N914B	376-022
CR5	1N270	376-031
CR6	1N270	376-031
CR7	1N746A; 3.3v, ±5%, 400 mw zener	347-017
CR8	1N270	347-031
CR9	1N270	347-031
CR10	1N270	347-031
CR11	CGD1419	11742
CR12	CGD1419	11742
CR13	CGD1419	11742
CR14	1N270	376-031
CR15	CGD1419	11742
CR16	CGD1419	11742
CR17	1N270	376-031
CR18	CGD1419	11742
CR19	1N270	376-031
CR20	CGD1419	11742
CR21	CGD1419	11742
CR22	CGD1419	11742
CR23	CGD1419	11742
CR24	CGD1419	11742
CR25	CGD1419	11742
CR26	1N914B	376-022
CR27	1N914B	376-022

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Diodes Contd.		
CR28	1.5 M39Z5; 39v, ±10%, 1.5w, zener	374-001
CR29	1N914B	376-022
CR30	1N914B	376-022
CR31	1N270	376-031
CR32	1N270	376-031
CR33	CGD1419	11742
CR101	1N4005	376-034
CR102	1N4005	376-034
CR103	1N4005	376-034
CR104	1N4005	376-034
CR105	1N4005	376-034
CR106	1N4005	376-034
CR107	1N4005	376-034
CR108	1N4005	376-034
CR109	1N4005	376-034
CR110	1N4005	376-034
CR111	1N753; 6.2v, ±10%, 400mw zener	374-019

3-5 ELECTRON TUBES

V1	7534/E130L, Pentode (Factory Selected)	10485
V101	6080, Twin Triode	670-017
V102	6080, Twin Triode	670-017
V103	6AU6, Pentode	670-010
V104	6AU6, Pentode	670-010
V105	OA2, Voltage Regulator	670-007
V106	7119, Twin Triode	670-021

3-6 INDUCTORS

L1	Choke Assembly	11456
L2	Choke Assembly	11456
L3	Choke Assembly	11456
L4	Choke Assembly	11456
L5	Choke Assembly	11456
L6	Choke Assembly	11456
L7	Choke Assembly	11456
L8	Choke Assembly	11456
L9	Filament Choke Assembly	10558
L10	1.5 μh Choke	335-002
L11	1.5 μh Choke	335-002
L12	1.5 μh Choke	335-002
L13	1.5 μh Choke	335-002

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.

3-7 RESISTORS

R1	2K, ±5%, 1/2w, carb. comp.	596-202
R2	2.5K, Pot., 10%, 2w, linear taper, composition	550-009
R3	100 Ω, ± 5%, 1/2w, carb. comp.	596-101
R4	10Ω, ±5%, 1/2w, carb. comp.	596-100
R5	180Ω, ±5%, 1/2w, carb. comp.	596-181
R6	10Ω, ±5%, 1/2w, carb. comp.	596-100
R7	150Ω, ±5%, 1/2w, carb. comp.	596-151
R8	200Ω, ±5%, 1/2w, carb. comp.	596-201
R9	1K, ±5%, 1/2w, carb. comp.	596-102
R10	3K, ±5%, 1/2w, carb. comp.	596-302
R11	1 Meg, ±5%, 1/2w, carb. comp.	596-105
R12	22K, ±5%, 1/2w, carb. comp.	596-223
R13	300Ω, ±5%, 1/2w, carb. comp.	596-301
R14	18K, ±5%, 1/2w, carb. comp.	596-183
R15	2.4K, ±5%, 1/2w, carb. comp.	596-242
R16	180Ω, ±5%, 1/2w, carb. comp.	596-181
R17	220Ω, ±5%, 1/2w, carb. comp.	596-221
R18	30K, ±5%, 1/2w, carb. comp.	596-303
R19	75Ω, ±5%, 1/2w, carb. comp.	596-750
R20	750Ω, ±5%, 1/2w, carb. comp.	596-751
R21	330Ω, ±5%, 1/2w, carb. comp.	596-331
R22	430Ω, ±5%, 1/2w, carb. comp.	596-431
R23	180Ω, ±5%, 1/2w, carb. comp.	596-181
R24	51Ω, ±5%, 1/2w, carb. comp.	596-510
R25	1K, ±5%, 1/2w, carb. comp.	596-102
R26	10K, Pot., 10%, 2w, linear taper, composition	550-012
R27	560Ω, ±5%, 1/2w, carb. comp.	596-561
R28	220Ω, ±5%, 1/2w, carb. comp.	596-221
R29	1KΩ, ±5%, 1/2w, carb. comp.	596-102
R30	2K, ±5%, 1/2w, carb. comp.	596-202
R31	300Ω, ±5%, 1/2w, carb. comp.	596-301
R32	330Ω, ±5%, 1/2w, carb. comp.	596-331
R33	430Ω, ±5%, 1/2w, carb. comp.	596-431
R34	750Ω, ±5%, 1/2w, carb. comp.	596-751
R35	75Ω, ±5%, 1/2w, carb. comp.	596-750
R36	51Ω, ±5%, 1/2w, carb. comp.	596-510
R37	160Ω, ±5%, 1/2w, carb. comp.	596-161
R38	1K, ±5%, 1/2w, carb. comp.	596-102
R39	10K, Pot., 10%, 2w, linear taper, composition.	550-012
R40	560Ω, ±5%, 1/2w, carb. comp.	596-561
R41	180Ω, ±5%, 1/2w, carb. comp.	596-181
R42	110Ω, ±5%, 1/2w, carb. comp.	596-111
R43	2K, ±5%, 1/2w, carb. comp.	596-202
R44	10K, ±5%, 1/2w, carb. comp.	596-103
R45	2 Meg, ±5%, 1/2w, carb. comp.	596-205
R46	3.3K, ±5%, 1/2w, carb. comp.	596-332
R47	330Ω, ±5%, 1/2w, carb. comp.	596-331
R48	5.1K, ±5%, 1/2w, carb. comp.	596-512
R49	430Ω, ±5%, 1/2w, carb. comp.	596-431

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Resistors Contd.		
R50	2K, ±5%, 1/2w, carb. comp.	596-202
R51	22K, ±5%, 1w, carb. comp.	597-223
R52	16K, ±5%, 2w, carb. comp.	598-163
R53	16K, ±5%, 2w, carb. comp.	598-163
R54	56K, ±5%, 1/2w, carb. comp.	596-563
R55	4.3K, ±5%, 1/2w, carb. comp.	596-432
R56	Not used	
R57	33K, ±5%, 2w, carb. comp. (Factory Selected)	598-333
R58	33K, ±5%, 2w, carb. comp. (Factory Selected)	598-333
R59	33K, ±5%, 2w, carb. comp. (Factory Selected)	598-333
R60	500Ω, Pot., 10%, 1/2w, linear taper, composition	550-029
R61	15Ω, ±5%, 1/2w, carb. comp.	596-150
R62	110Ω, ±5%, 1/2w, carb. comp.	596-111
R63	240Ω, ±5%, 2w, carb. comp.	598-241
R64	240Ω, ±5%, 2w, carb. comp.	598-241
R65	240Ω, ±5%, 2w, carb. comp.	598-241
R66	240Ω, ±5%, 2w, carb. comp.	598-241
R67	100Ω, ±5%, 2w, carb. comp.	598-101
R68	100Ω, ±5%, 2w, carb. comp.	598-101
R69	100Ω, ±5%, 2w, carb. comp.	598-101
R70	100Ω, ±5%, 2w, carb. comp.	598-101
R71	240Ω, ±5%, 2w, carb. comp.	598-241
R72	240Ω, ±5%, 2w, carb. comp.	598-241
R73	240Ω, ±5%, 2w, carb. comp.	598-241
R74	240Ω, ±5%, 2w, carb. comp.	598-241
R75	240Ω, ±5%, 2w, carb. comp.	598-241
R76	240Ω, ±5%, 2w, carb. comp.	598-241
R77	13Ω, ±5%, 1w, carb. comp.	597-130
R78	13Ω, ±5%, 1w, carb. comp.	597-130
R79	13Ω, ±5%, 1w, carb. comp.	597-130
R80	12Ω, ±5%, 1w, carb. comp.	597-120
R81	3.3Ω, ±5%, 1w, carb. comp.	597-033
R82	5.1Ω, ±5%, 1w, carb. comp.	597-051
R83	5.1Ω, ±5%, 1/2w, carb. comp.	596-051
R84	82K, ±5%, 1/2w, carb. comp.	596-823
R85	3.9K, ±5%, 1/2w, carb. comp.	596-392
R86	47K, ±5%, 1w, carb. comp.	597-473
R87	1K, ±5%, 1/2w, carb. comp.	596-102
R88	240Ω, ±5%, 2w, carb. comp.	598-241
R89	240Ω, ±5%, 2w, carb. comp.	598-241
R101	30Ω, ±5%, 1w, carb. comp.	597-300
R102	5Ω, 10w, wirewound	610-017
R103	30Ω, ±5%, 1w, carb. comp.	597-300
R104	4K, 10w, wirewound	610-020
R105	62K, ±5%, 1/2w, carb. comp.	596-623
R106	160K, ±5%, 1/2w, carb. comp.	596-164
R107	360K, ±5%, 1/2w, carb. comp.	596-364
R108	100Ω, ±5%, 1/2w, carb. comp.	596-101
R109	22Ω, ±5%, 1/2w, carb. comp.	596-220
R110	30K, ±5%, 1w, carb. comp.	597-303
R111	150K, ±5%, 1/2w, carb. comp.	596-154
R112	50K, Pot., 10%, 2w, Locking, linear taper	545-008
R113	160K, ±5%, 1/2w, carb. comp.	596-164
R114	22Ω, ±5%, 1/2w, carb. comp.	596-220
R115	100Ω, ±5%, 1/2w, carb. comp.	596-101
R116	100Ω, ±5%, 1/2w, carb. comp.	596-101
R117	22Ω, ±5%, 1/2w, carb. comp.	596-220
R118	22Ω, ±5%, 1/2w, carb. comp.	596-220
R119	100Ω, ±5%, 1/2w, carb. comp.	596-101
R120	100K, ±5%, 1/2w, carb. comp.	596-104
R121	51K, ±5%, 1/2w, carb. comp.	596-513
R122	180Ω, ±5%, 1/2w, carb. comp.	596-181
R123	27K, ±5%, 2w, carb. comp.	598-273
R124	10K, ±5%, 1/2w, carb. comp.	596-103
R125	5Ω, 3w, 5%, wirewound	610-003
R126	100K, ±5%, 1/2w, carb. comp.	596-104
R127	160K, ±5%, 1/2w, carb. comp.	596-164
R128	100K, Pot., 10%, 2w, linear taper composition	550-006
R129	150K, ±5%, 1/2w, carb. comp.	596-154
R130	2.7Ω, ±5%, 1w, carb. comp.	597-027
R131	2.7Ω. ±5%, 1w, carb. comp.	597-027
R132	150Ω. ±5%, 1/2w, carb. comp.	596-151
R133	150Ω, ±5%, 1/2w, carb. comp.	596-151
R134	200Ω, Pot., 10%, 1/2w, Miniature, Multiturn, linear taper, wirewound	551-017
R135	510Ω, ±5%, 1/2w, carb. comp.	596-511
R136	510Ω, ±5%, 1/2w, carb. comp.	596-511
R137	510Ω, ±5%, 1/2w, carb. comp.	596-511
R138	510Ω, ±5%, 1/2w, carb. comp.	596-511
R139	750Ω, ±5%, 1/2w, carb. comp.	596-751
R140	510Ω, ±5%, 1/2w, carb. comp.	596-511
R141	15Ω, ±5%, 1/2w, carb. comp.	596-150
R142	511Ω, ±1%, 1/2w, metal film	618-002
R143	475Ω, ±1%, 1/2w, metal film	618-015
R144	100K, ±5%, 1/2w, carb. comp.	596-104
R145	Not used	
R146	39K, ±5%, 2w, carb. comp.	598-393

3-8 SWITCHES

S1	12 Pos., Single Pole Rotary	624-040
S2	6 Pos., 2 Pole Rotary	624-005
S3	6 Pos., 2 Pole Rotary	624-005
S4	2 Pos., 5 Pole Rotary	624-008

CIRCUIT REFERENCE	DESCRIPTION	E-H PART NO.
Switches Contd.		
S5	6 Pos., 2 Pole Rotary	624-004
S6	Pushbutton	635-003
S7	Toggle, DPDT	630-006
S101	Toggle, DPDT	630-006

3-9 TRANSFORMERS

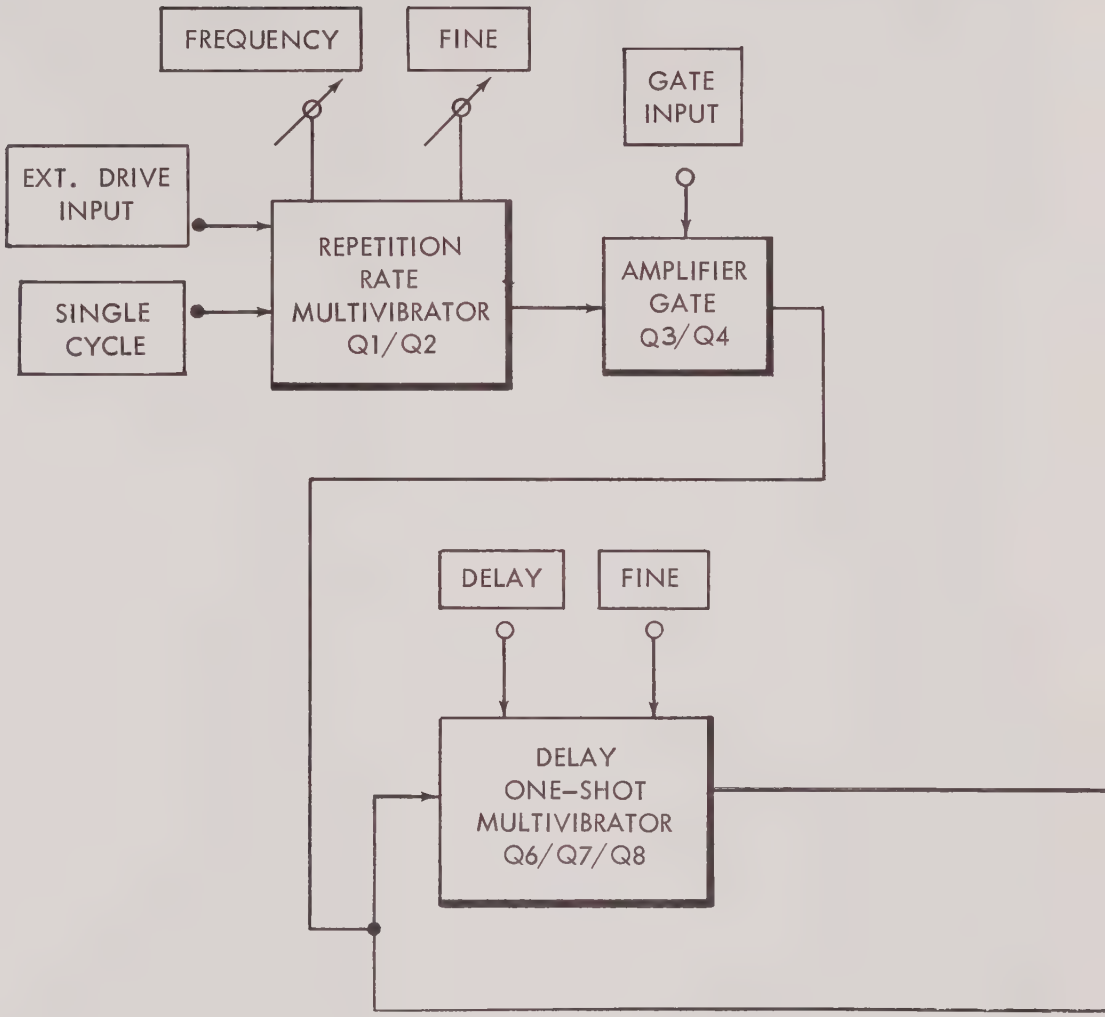
T1	E-H Special Assembly	10660
T2	E-H Special Assembly	10661
T3	E-H Special Assembly	A-10928
T101	Power Transformer	10560

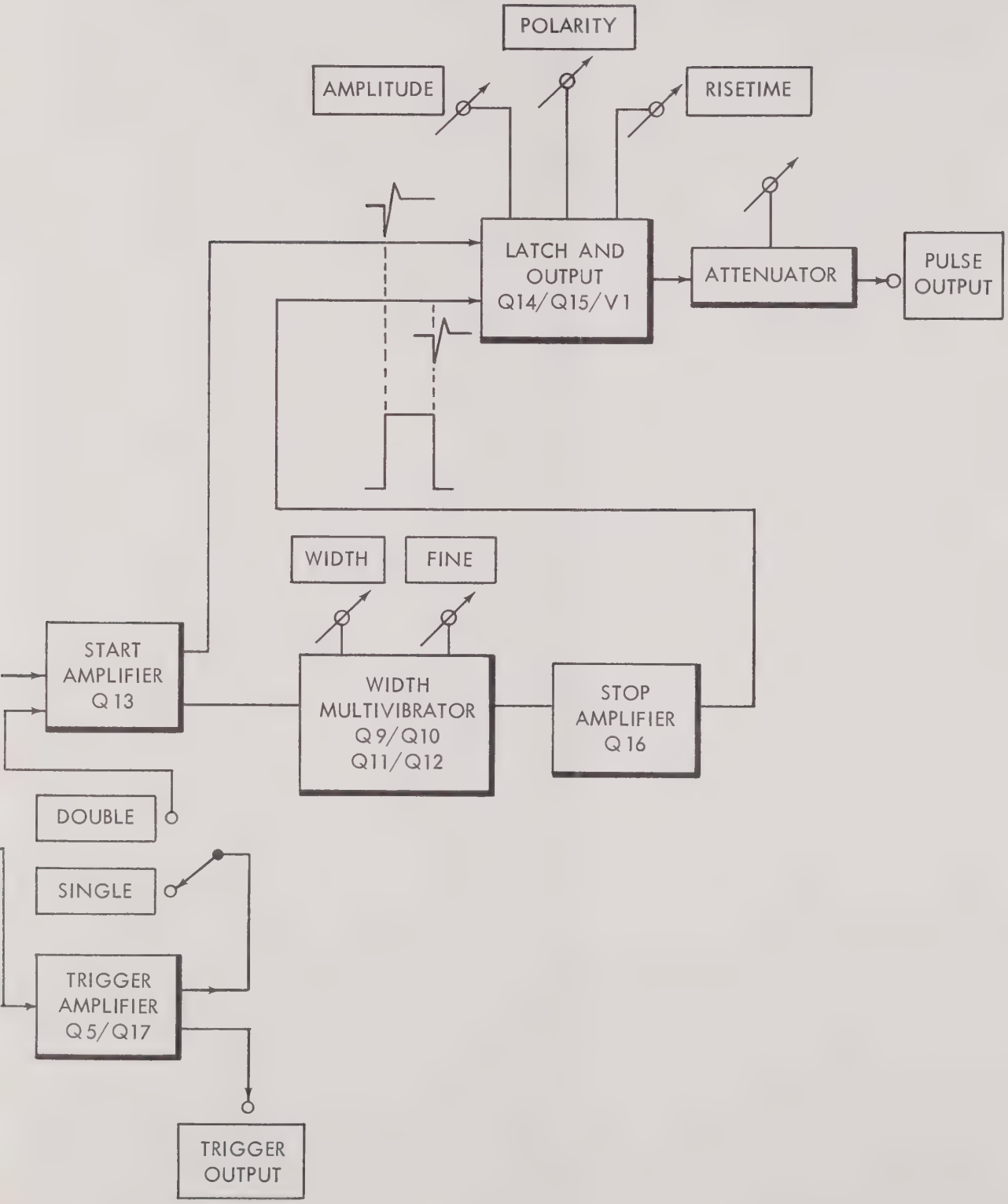
3-10 TRANSISTORS

Q1	2N966	663-032
Q2	2N966	663-032
Q3	2N966	663-032
Q4	2N966	663-032
Q5	2N706A	663-022
Q6	2N966	663-032
Q7	2N966	663-032
Q8	2N966	663-032
Q9	2N966	663-032
Q10	2N966	663-032
Q11	2N966	663-032
Q12	2N966	663-032
Q13	2N2369	663-009
Q14	2N2098	11706
Q15	2N2538	663-003
Q16	2N834	663-028
Q17	2N706A	663-022
Q101	2N1309	663-021
Q102	2N1306	663-018
Q103	2N1309	663-021
Q104	2N250	11705
Q105	2N250	11705

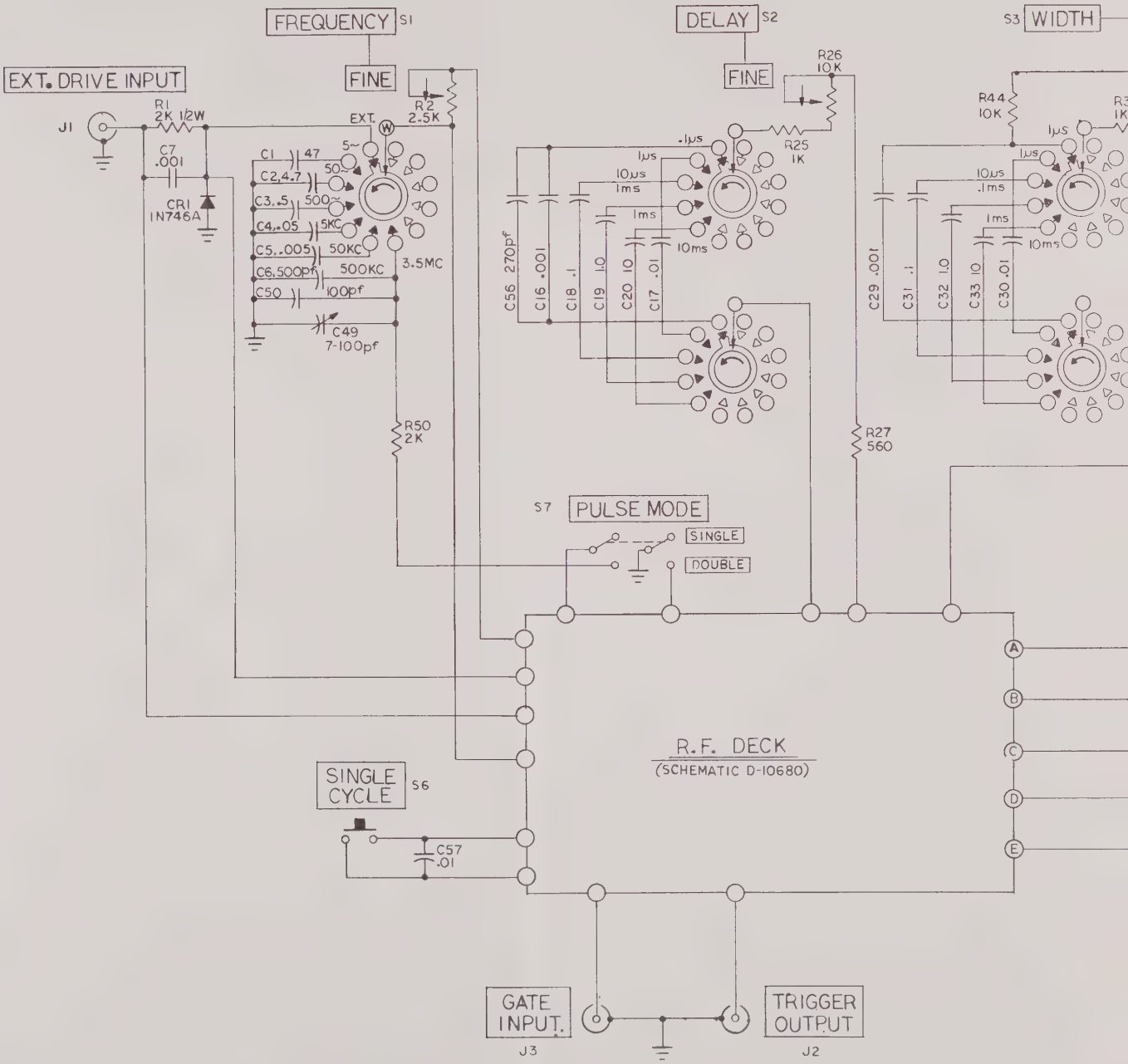
3-11 MISCELLANEOUS

J-1	Connector, BNC UG-1094/U	721-013
J2	Connector, BNC UG-1094/U	721-013
J3	Connector, BNC UG-1094/U	721-013
J4	Connector, BNC UG-1094/U	721-013
	Core, Ferrite (4)	361-002
	Core, Ferrite (1)	361-011
	Fan Blade; 4" 10 Blade clockwise	493-004
	Fan Motor	570-001
	Fan, Venturi Tube	10322
	Fuse Holder (1)	396-001
F101	Fuse, 3A, Slo-Blo (1)	398-003
F102	Fuse, 1.5A, Slo-Blo (1)	398-013
	Insulator, Electrolytic Capacitor	330-007
	Knob, Large (1)	443-007
	Knob, Medium (4)	443-008
	Knob, Small (5)	443-009
DS1	Pilot Light Assembly, Neon Red	510-008
	Power Cord (1)	786-001
	Shaft, with Panel Bushing (3)	465-002
	Shaft Couplet (3)	465-001
	Socket, Transistor (4)	490-002
	Socket, Tube, Octal (3)	495-013
	Socket, Tube, 9 Pin Miniature (1)	495-019


FREQUENCY
FINE
GATE INPUT
EXT. DRIVE INPUT
SINGLE CYCLE
REPETITION RATE MULTIVIBRATOR Q1/Q2
AMPLIFIER GATE Q3/Q4
DELAY
FINE
DELAY ONE-SHOT MULTIVIBRATOR Q6/Q7/Q8

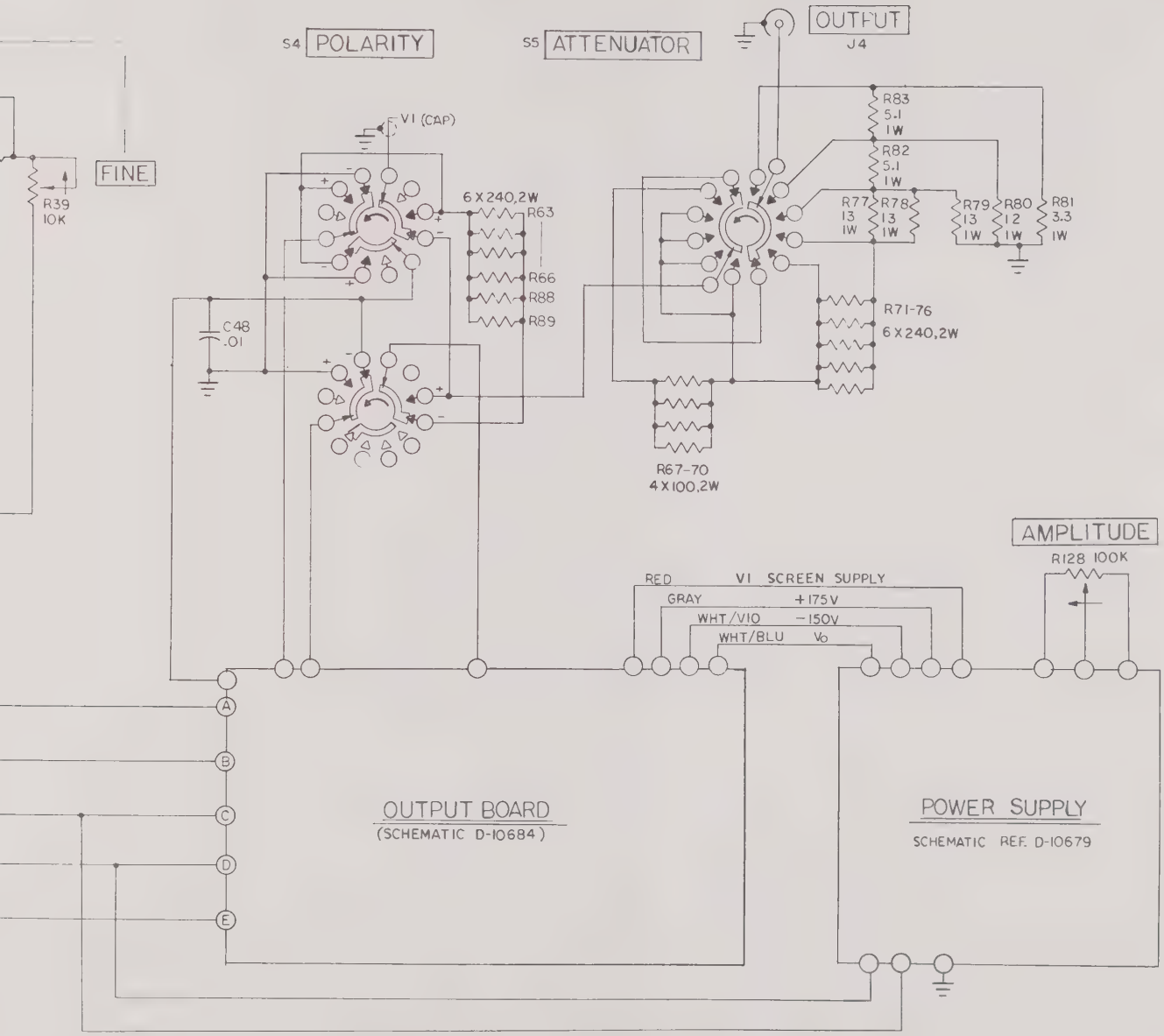


ENERATOR - BLOCK DIAGRAM


FREQUENCY S1
FINE
EXT. DRIVE INPUT
J1
R1 2K 1/2W
C7 .001
CR1 1N746A
EXT.
R2 2.5K
C1 47
C2,4.7
C3,.5
C4,.05
C5,.005
C6,500pf
C50 100pf
C49 7-100pf
5~
50~
500~
5KC
50KC
500KC
3.5MC
R50 2K
DELAY S2
FINE
R26 10K
R25 1K
.1μs
1μs
10μs
1ms
10ms
C56 270pf
C16 .001
C18 .1
C19 1.0
C20 10
C17 .01
S3 WIDTH
R44 10K
C29 .001
C31 .1
C32 1.0
C33 10
C30 .01
R27 560
S7 PULSE MODE
SINGLE
DOUBLE
R.F. DECK
(SCHEMATIC D-10680)
A
B
C
D
E
SINGLE CYCLE S6
C57 .01
GATE INPUT. J3
TRIGGER OUTPUT J2

D-11645-A

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E O
A	ORIG RELEASE	9/24/65	RS.			



PROPRIETARY INFORMATION
NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF E-H RESEARCH LABORATORIES, INC.

ITEM NO | PART NO | DESCRIPTION | QTY

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE NONE
DIMENSIONS ARE IN INCHES
DECIMALS ± XX = ± XXX –
ANGLES ±
MACHINED SURFACES
DO NOT SCALE DRAWING
FINISH

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE
MASTER SCHEMATIC

MODEL: 132A

DRAWN Rexal 9/24/65
CHK'D 9.27
APP'D

D-11645 | SIZE A

SHEET NO 1 OF 1 SHEETS

NEXT ASS'Y
USED ON | REQ'D

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E. O.
G	ADDED DOUBLE PULSE	4/26/65	R.S.	[illegible]		65-34
H	COMP. CHANGES	7/7/65	R.S.	[illegible]		65-46
J	R50 WAS 3K	7-14-65	[illegible]			65-51
K	R11 WAS 2K & ADDED C57	8.2.65	S.R.			
L	ADDED TEST POINT Nº'S	9/1/65	R.S.			—

PROPRIETARY INFORMATION
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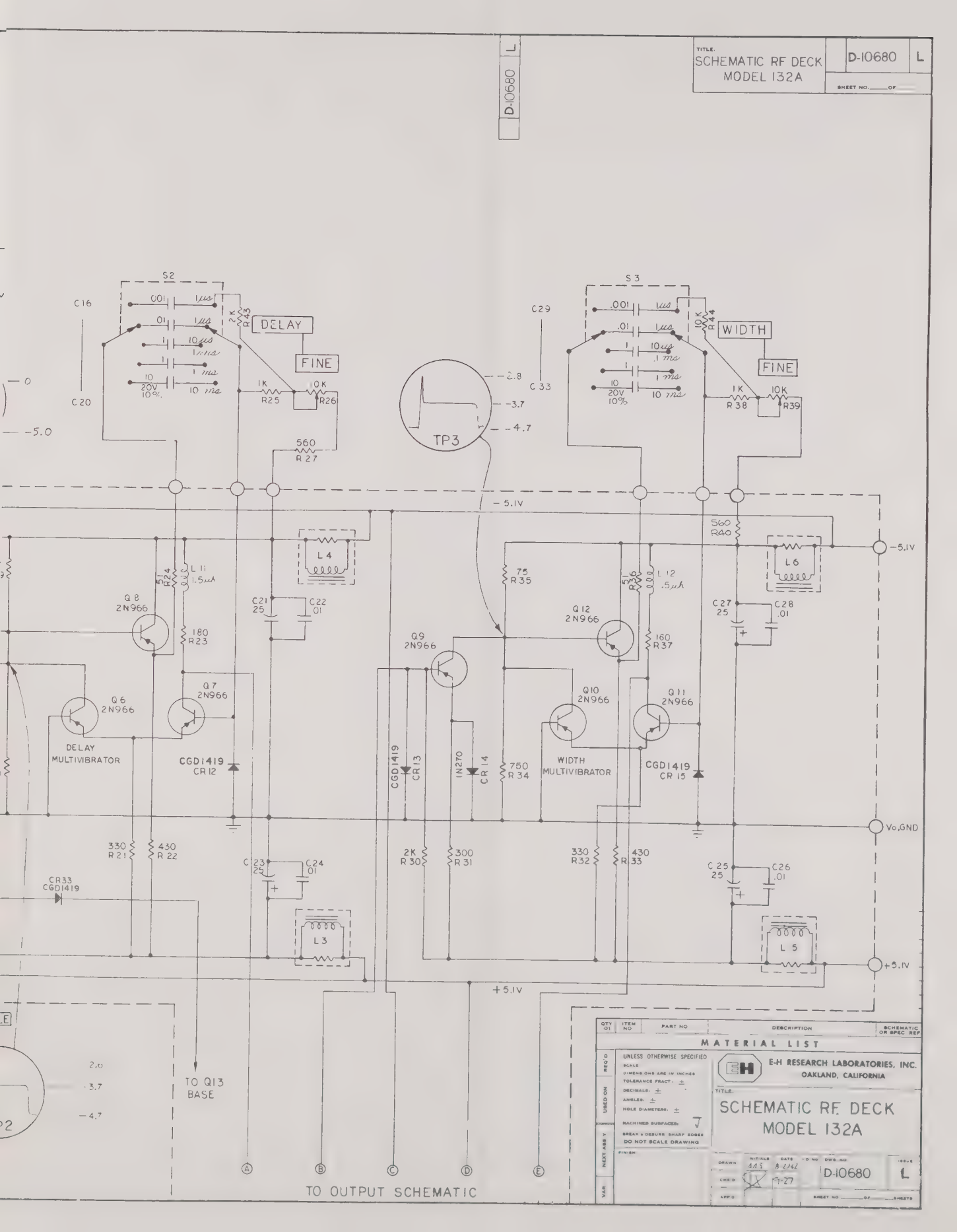
EXT. DRIVE INPUT
C1 — C5
4.7
.05
47
.5
.005
100 PF C50
500 PF C6
7-100PF C49
5 KC
50 KC
500 KC
3.5MC
50Ω
500Ω
5Ω
S1
R1 2K, 1/2W
EXT
C7 .001
CR1 IN746
FREQUENCY
FINE
2.5K
R2
R50 2K
S7B
D S
+5.1V
TP1
-2.0
-5.0
GATE INPUT
TRIGGER OUTPUT
.03μS
C57 .01
SINGLE CYCLE
S6
C51 .01
C52 .01
R29 1K
R11 1M
R42 110
R45 2 Meg
L1
-5.1 V
1.5μh L10
C8 25
C9 .01
100 R3
150 R7
200 R8
IN751A
CR 3
Q1 2N966
Q2 2N966
CLOCK MULTIVIBRATOR
10 R4
10 R6
1K R9
3K R10
180 R5
C10 25
C11 .01
L2
+5.1 V
C12 10P
AMPLIFIER
Q3 2N966
Q4 2N966
GATE AMPLIFIER
IN914B CR4
IN270 CR5
CR 6 IN270
CR 7 IN746
2.4K R15
C13 100PF
CR8-9 2x IN270
22K R12
300 R13
18K R14
R41 180
R28 220
C14 .01
220 R17
30K R18
Q5 2N706A
TRIGGER OUTPUT AMPLIFIER
C15 150P
IN270 CR10
CGD1419 CR11
C53 100 pf
Q17 2N706A
TRIGGER OUTPUT AMPLIFIER
CR31 IN270
CR32 IN270
R16 180
T3 A-10928
PRINTED CIRCUIT BOARD
DOUBLE
S7A
PULSE MODE
SIN

NOTES:
UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTANCES GIVEN IN OHMS.
2. ALL CAPACITANCES GIVEN IN MICRO-FARADS (PF = PICO FARADS).
3. WAVEFORMS OBSERVED ON "TEKTRONIX" MODEL 541A OSCILLOSCOPE (TYPE L PLUG-IN).
MODEL 132A CONTROLS SET AS FOLLOWS:
(A) FREQUENCY RANGE - 50KC TO 500KC, FINE-SET TO MAX. (FULL CW)
(B) DELAY RANGE - 1.0μS TO 10μS, FINE - SET TO MIN (FULL CCW)
(C) WIDTH RANGE - 1.0μS TO 10μS, FINE - SET TO MIN (FULL CCW)


D-10680 L
TITLE. SCHEMATIC RF DECK MODEL 132A
D-10680 L
SHEET NO. OF
S2
S3
DELAY
FINE
WIDTH
FINE
TP3
-2.8
-3.7
-4.7
-5.0
-5.1V
+5.1V
Vo,GND
+5.1V
DELAY MULTIVIBRATOR
WIDTH MULTIVIBRATOR
CGD1419 CR12
CGD1419 CR13
IN270 CR14
CGD1419 CR15
CR33 CGD1419
Q6 2N966
Q7 2N966
Q8 2N966
Q9 2N966
Q10 2N966
Q11 2N966
Q12 2N966
L4
L5
L6
L3
L11 1.5μh
L12 .5μh
C16
C20
C29
C33
C21 25
C22 .01
C23 25
C24 .01
C25 25
C26 .01
C27 25
C28 .01
R23 180
R24 51
R25 1K
R26 10K
R27 560
R30 2K
R31 300
R32 330
R33 430
R34 750
R35 75
R36 51
R37 160
R38 1K
R39 10K
R40 560
R43 2K
R44 10K
R21 330
R22 430
TO Q13 BASE
TO OUTPUT SCHEMATIC
MATERIAL LIST
QTY 01 | ITEM NO | PART NO | DESCRIPTION | SCHEMATIC OR SPEC REF
UNLESS OTHERWISE SPECIFIED
SCALE
DIMENSIONS ARE IN INCHES
TOLERANCE FRACT. ±
DECIMALS ±
ANGLES ±
HOLE DIAMETERS ±
MACHINED SURFACES
BREAK & DEBURR SHARP EDGES
DO NOT SCALE DRAWING
FINISH
E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA
TITLE.
SCHEMATIC RF DECK
MODEL 132A
DRAWN AAS 8-2162
CHK'D
APP'D
D-10680 L
SHEET NO. OF SHEETS

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E.O
A	ORIG. REL.	8/62				
B	REVISED	3/63				
C	REVISED	6/1963	L B	RH		
D	R57,58,59 WERE 18K 2W 5%	9/6/63	RSH	RSH		63-63
E	Q.3 WAS 2N706A-Q14 WAS 663-0108	10/7/63	RSH	RSH		63-72
F	C36 WAS 50P & CR18 WAS IN914B	4-64	RSH	RSH		64-20
G	Q16 WAS 2N706A	9/1/64	R.S.	RSH		64-42
H	ADDED SELECTED RESISTOR	9/17/64	R.S.	RSH		64-59
J	RESISTOR CHANGE	11/18/64	R.S.	RSH		64-71
K	DIODE CHANGES	9/14/65	R.S.	RSH		65-71
L	CR16 WAS IN914B	7/7/66	R.S.	RSH		65-86
M	ADDED TEST POINT Nº'S	9/7/65	R.S.			—

PROPRIETARY INFORMATION
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TP8
0 V
-40
.1μS
.03μS

TP7
+5.1
+1.2
.18μS

TP5
+.2
-.6
.35μS
Q16 REMOVED

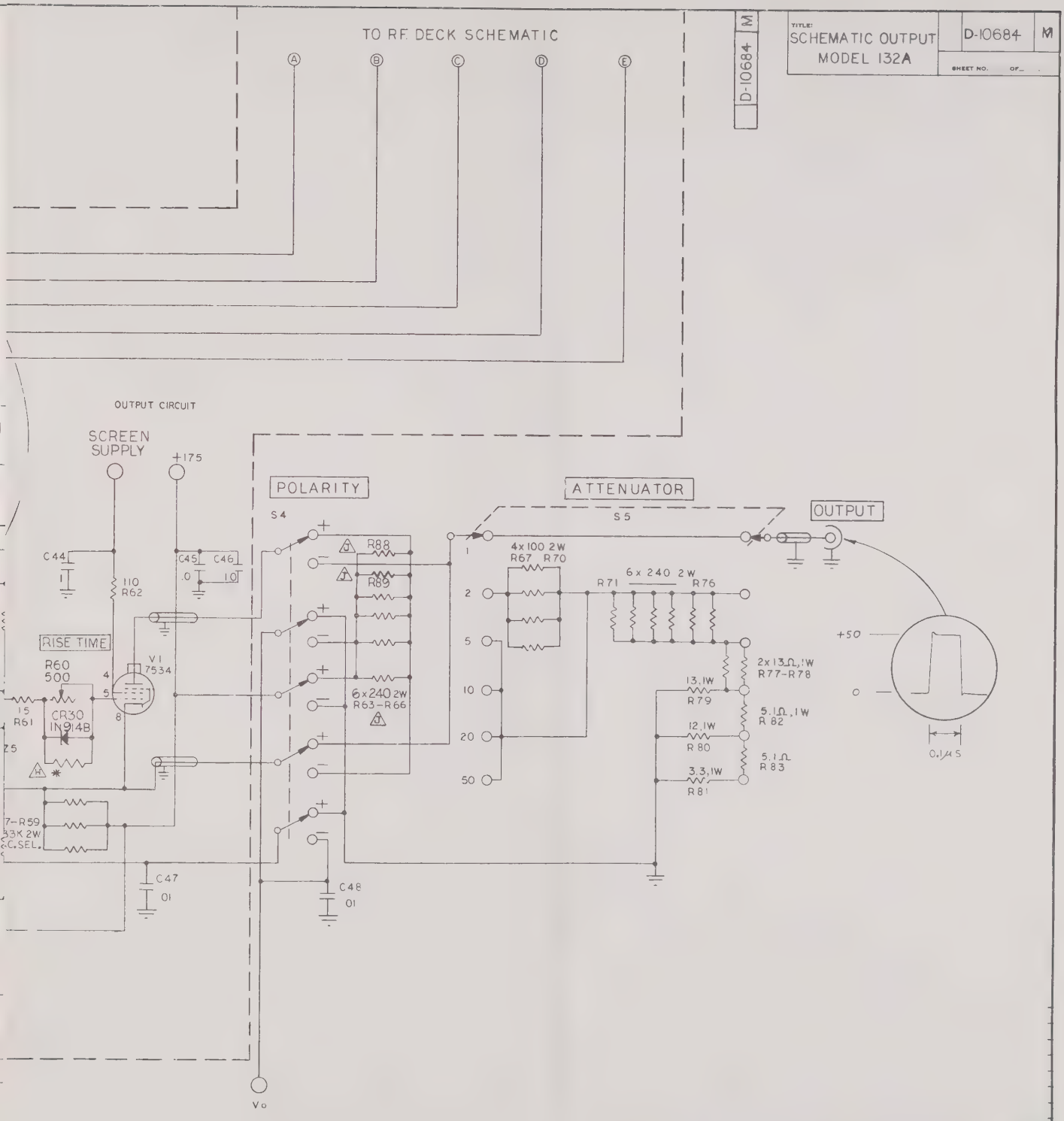
TP6
+5.1
+3.4
.18μS

TP4
+1.8
-.6
.35μS
Q13 REMOVED

L7
L8
C34-C35
.01
25 +
C36 100PF
C38 100PF
C40 50PF
C41 .01
C42 25 +
T1
T2
IK R87
Q16 2N834
STOP AMPLIFIER
CR16 CGD1419
3.3K R46
330 R47
C37 150PF
CR17 IN270
Q13 2N2369
START AMPLIFIER
CR18
5.1K R48
430 R49
C39 .001
CR19 IN270
LATCH CIRCUIT
R51
R54
-150
22K 1W
16K 2W
16K 2W
56K
CR20
CR21
Q15 2N2538
CR26 IN914B
4.3K R55
CR27 IN914
CR22
CR23
CR24
CR25
Q14 2N2098
C43 .1
CR28 1.5M3
CR29 IN914B
3.9K R85
82K R84
47K 1W R86
TP9
+42
-150
.5μS
NOTE - INCREASE "WIDTH" TO .5μS PULSE
PRINTED CIRCUIT BOARD

NOTES:
UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTANCES GIVEN IN OHMS.
2. ALL CAPACITANCES GIVEN IN MICRO-FARADS (PF=PICO FARAD)
3. WAVEFORMS OBSERVED ON "TEKTRONIX" MODEL 541A OSCILLOSCOPE (TYPE L PLUG-IN). MODEL 132A CONTROLS SET AS FOLLOWS:
   (A) FREQUENCY RANGE - 50KC TO 500KC, FINE - SET TO MAX. (FULL CW)
   (B) DELAY RANGE - 0μS TO 1.0μS FINE-SET TO MIN. (FULL CCW)
   (C) WIDTH RANGE -0.1μS TO 1.0μS FINE - SET TO MIN. (FULL CCW)
   (D) RISE TIME - SET TO MIN. (FULL CCW)
   (E) AMPLITUDE - SET TO MAX. (FULL CW)
4. * FACTORY SELECTED.
5. ALL DIODES ARE, CGD1419.
6. TP - INDICATES TEST POINT IN CIRCUITRY.

+50
-39



TITLE: SCHEMATIC OUTPUT MODEL 132A	D-10684	M
	SHEET NO.	OF

D-10684 M

QTY -01	ITEM NO	PART NO.	DESCRIPTION	SCHEMATIC OR SPEC. REF

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE
DIMENSIONS ARE IN INCHES
TOLERANCE FRACT ±
DECIMALS ±
ANGLES ±
HOLE DIAMETERS ±
MACHINED SURFACES √
BREAK & DEBURR SHARP EDGES
DO NOT SCALE DRAWING
FINISH

REQ'D | USED ON | NEXT ASSY | VAR

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE
SCHEMATIC OUTPUT
MODEL 132A

	INITIALS	DATE	I.D. NO	DWG. NO	
DRAWN	AAS	3-28-62		D-10684	M
CHK'D	[illegible]	[illegible]			
APP'D	RB	4/9/62		SHEET NO. 1 OF 1 SHEETS	

REVISIONS						
ISSUE	REVISION	DATE	DRAWN	CHK'D	APPV'D	E. O.
A	ORIGINAL	8/15	MS			
B	REVISED	3/63				
C	C108 WAS 100uf/450V	4-16-64	KK	BH		64-20
D	ADDED CIRCUITRY IDENT.	9/2/65	R.S.			—
E	ADDED C115 & R147	11-10-65	RS			65-93

PROPRIETARY INFORMATION
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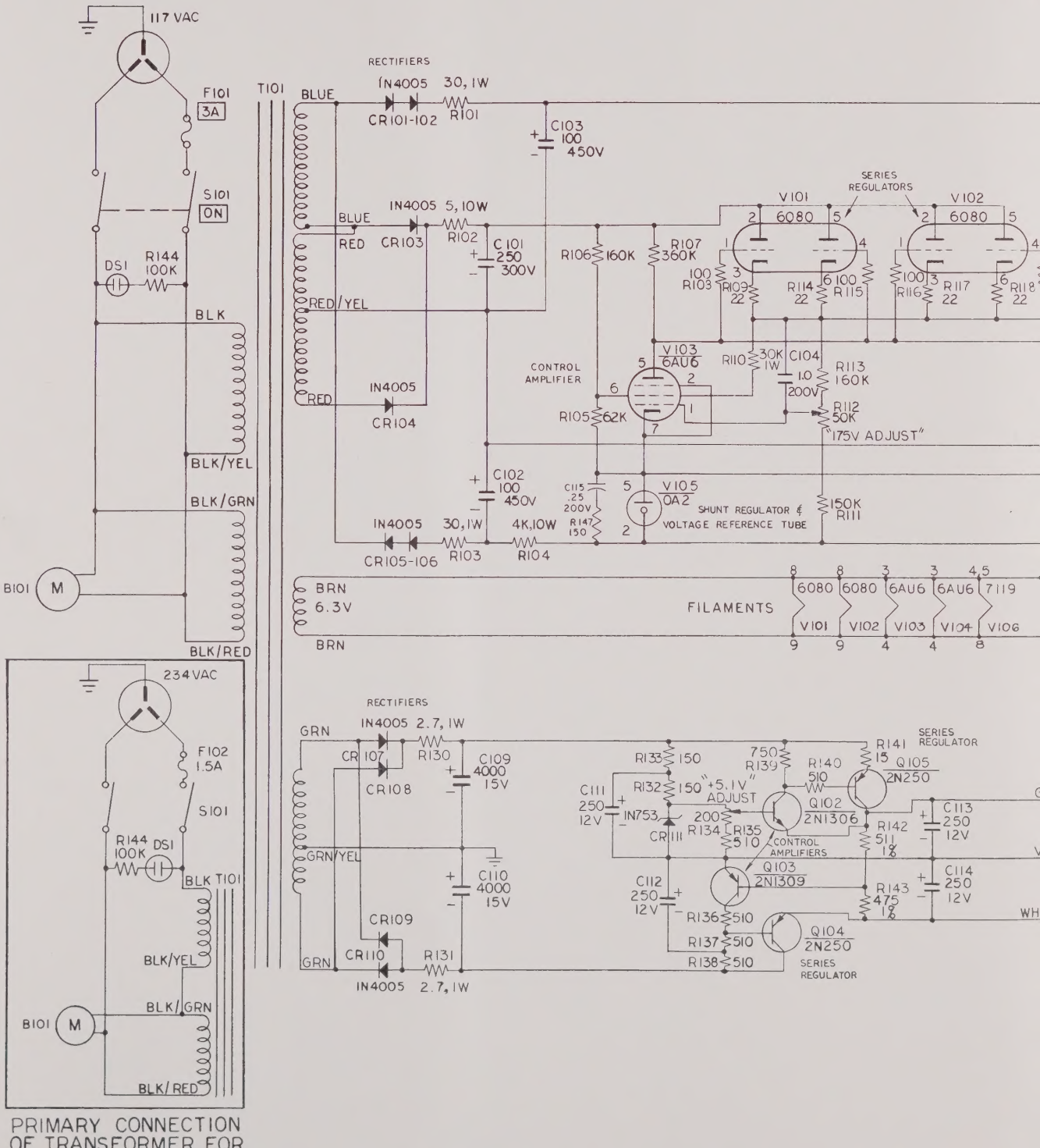
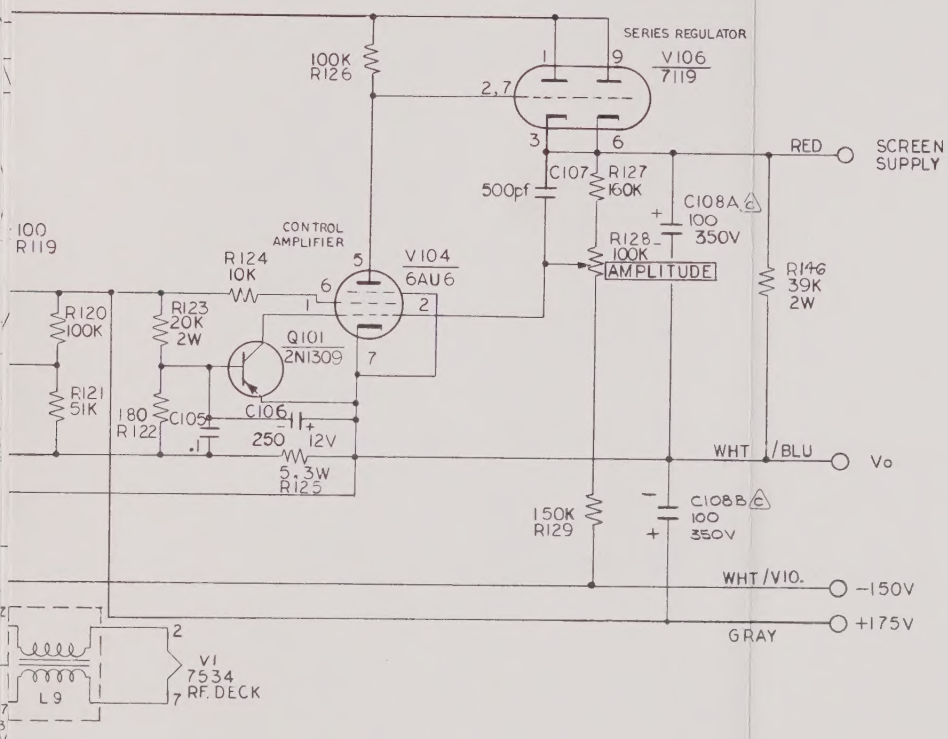


PRIMARY CONNECTION OF TRANSFORMER FOR 234V AC

D-10679 E

TITLE: MODEL 132 POWER SUPPLY | D-10679 E | SHEET NO. ___ OF ___



REEN +5.1V

OLET

/GRN -5.1V

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCES GIVEN IN OHMS
2. ALL RESISTORS ARE $\frac{1}{2}$W, 5%
3. ALL CAPACITANCES GIVEN IN MICRO-FARAD. (Pf = PICO FARADS)

QTY -01	ITEM NO.	PART NO.	DESCRIPTION	SCHEMATIC OR SPEC. REF

MATERIAL LIST

UNLESS OTHERWISE SPECIFIED
SCALE:
DIMENSIONS ARE IN INCHES
TOLERANCE FRACT: ±
DECIMALS: ±
ANGLES: ±
HOLE DIAMETERS: ±
MACHINED SURFACES: √
BREAK & DEBURR SHARP EDGES
DO NOT SCALE DRAWING
FINISH:

REQ'D | USED ON | NEXT ASSY | VAR.

E-H RESEARCH LABORATORIES, INC.
OAKLAND, CALIFORNIA

TITLE:
MODEL 132 A
POWER SUPPLY

	INITIALS	DATE	I.D. NO.	DWG. NO.	ISSUE
DRAWN	WAS	8/15		D-10679	E
CHK'D	[illegible]	9/2/65			
APP'D	[illegible]	9/2/65		SHEET NO. 1 OF 1 SHEETS	

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